FIG. 1

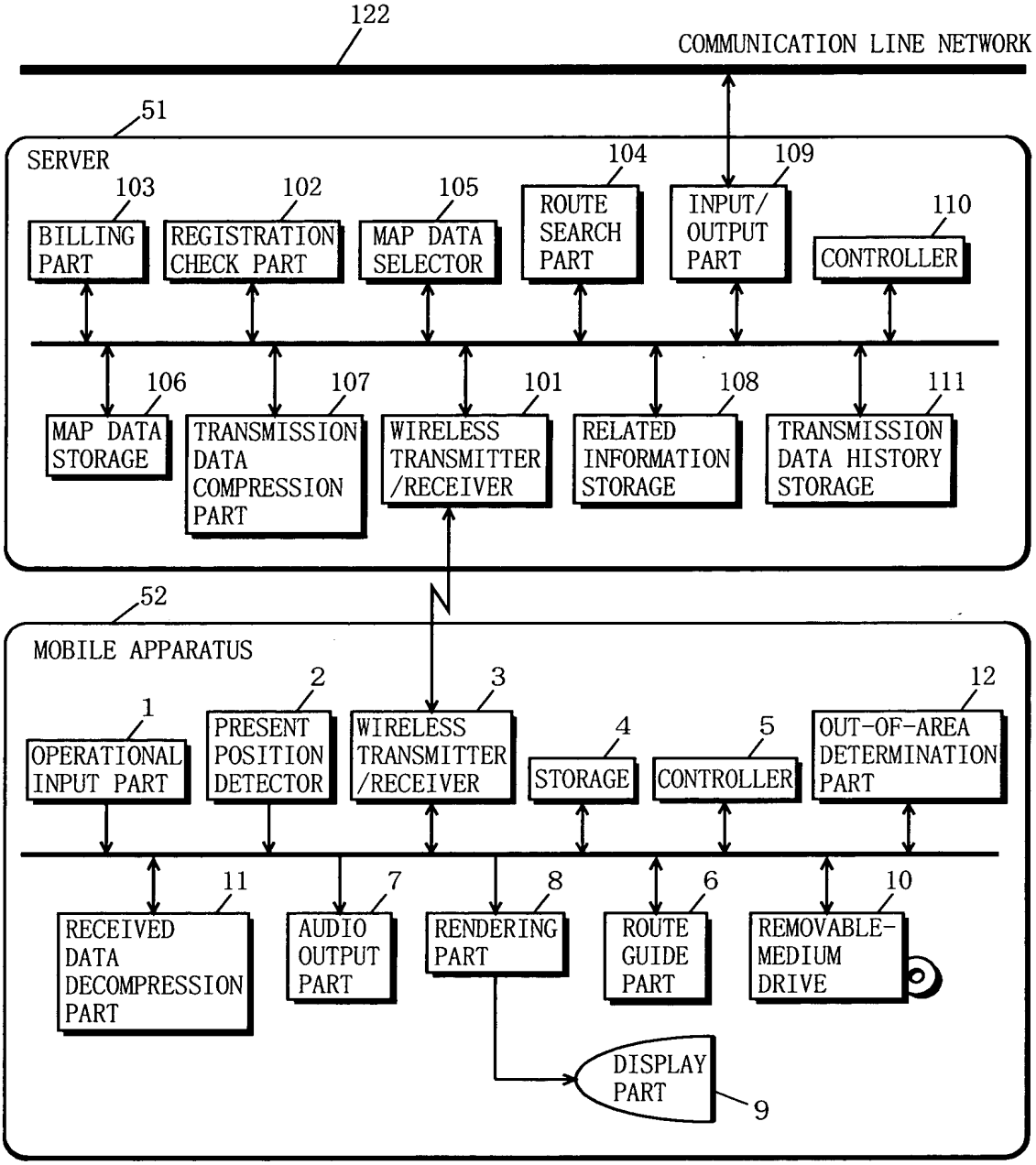
122
COMMUNICATION LINE NETWORK
51
SERVER
103
BILLING PART
102
REGISTRATION CHECK PART
105
MAP DATA SELECTOR
104
ROUTE SEARCH PART
109
INPUT/ OUTPUT PART
110
CONTROLLER
106
MAP DATA STORAGE
107
TRANSMISSION DATA COMPRESSION PART
101
WIRELESS TRANSMITTER /RECEIVER
108
RELATED INFORMATION STORAGE
111
TRANSMISSION DATA HISTORY STORAGE
52
MOBILE APPARATUS
1
OPERATIONAL INPUT PART
2
PRESENT POSITION DETECTOR
3
WIRELESS TRANSMITTER /RECEIVER
4
STORAGE
5
CONTROLLER
12
OUT-OF-AREA DETERMINATION PART
11
RECEIVED DATA DECOMPRESSION PART
7
AUDIO OUTPUT PART
8
RENDERING PART
6
ROUTE GUIDE PART
10
REMOVABLE-MEDIUM DRIVE
DISPLAY PART
9

FIG. 2A

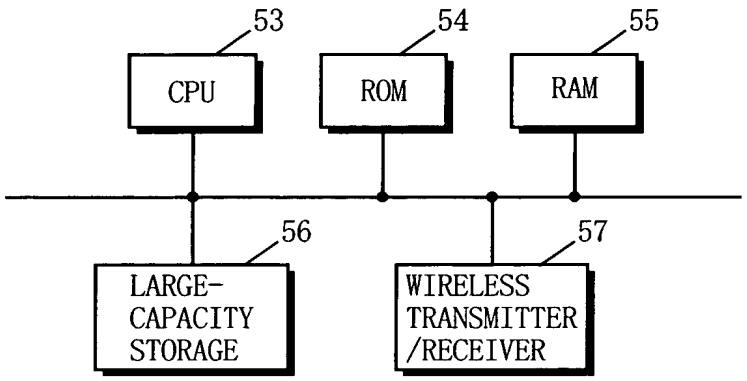
53
54
55
CPU
ROM
RAM
56
57
LARGE-
CAPACITY
STORAGE
WIRELESS
TRANSMITTER
/RECEIVER

FIG. 2B

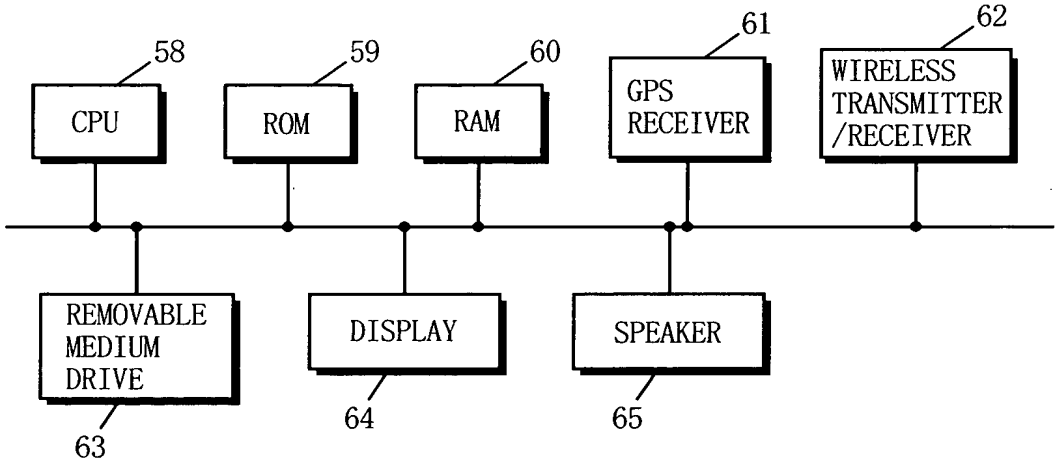
58
59
60
61
62
CPU
ROM
RAM
GPS
RECEIVER
WIRELESS
TRANSMITTER
/RECEIVER
REMOVABLE
MEDIUM
DRIVE
DISPLAY
SPEAKER
63
64
65

FIG. 3A

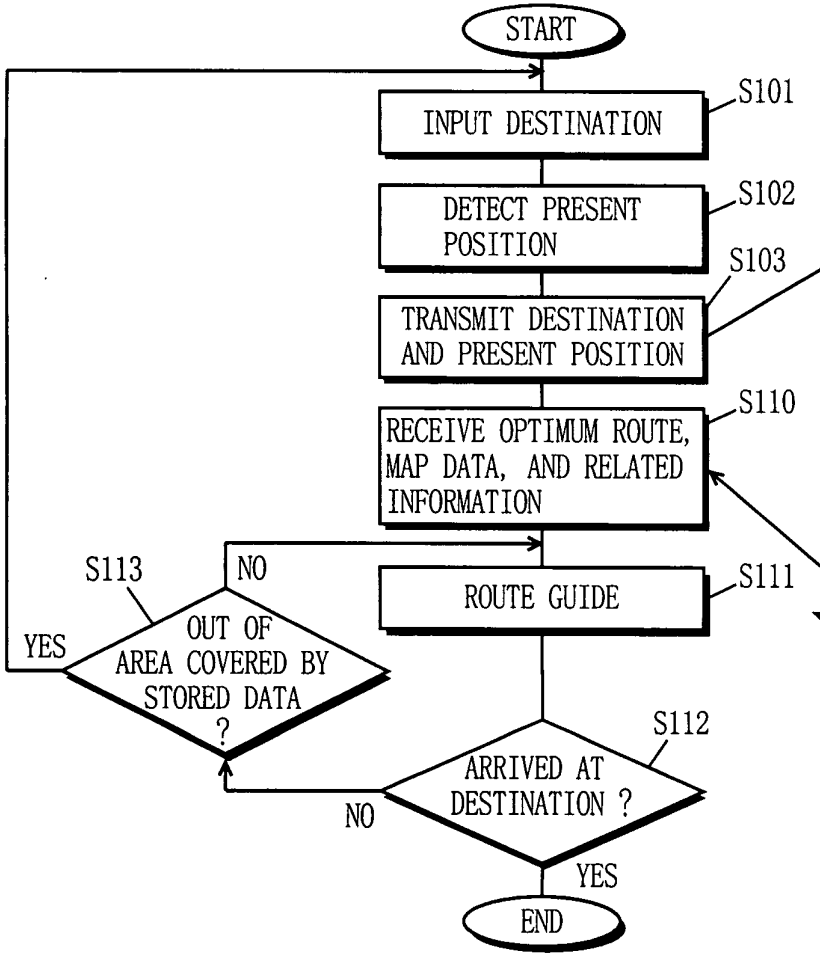
START
INPUT DESTINATION
S101
DETECT PRESENT POSITION
S102
TRANSMIT DESTINATION AND PRESENT POSITION
S103
RECEIVE OPTIMUM ROUTE, MAP DATA, AND RELATED INFORMATION
S110
ROUTE GUIDE
S111
ARRIVED AT DESTINATION ?
S112
NO
YES
END
OUT OF AREA COVERED BY STORED DATA ?
S113
NO
YES

FIG. 3B

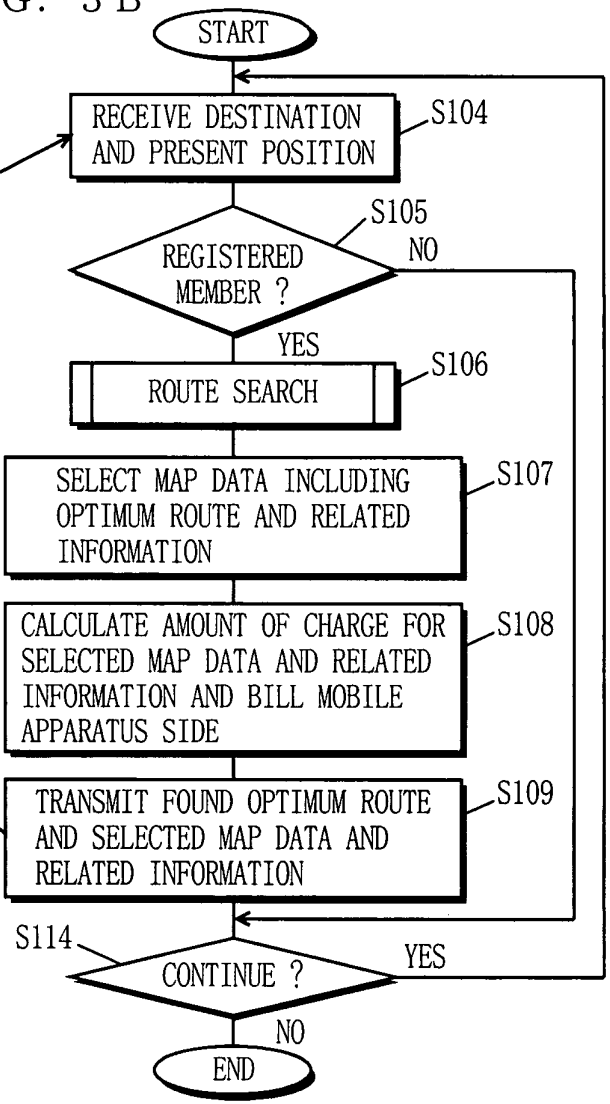
START
RECEIVE DESTINATION AND PRESENT POSITION
S104
REGISTERED MEMBER ?
S105
NO
YES
ROUTE SEARCH
S106
SELECT MAP DATA INCLUDING OPTIMUM ROUTE AND RELATED INFORMATION
S107
CALCULATE AMOUNT OF CHARGE FOR SELECTED MAP DATA AND RELATED INFORMATION AND BILL MOBILE APPARATUS SIDE
S108
TRANSMIT FOUND OPTIMUM ROUTE AND SELECTED MAP DATA AND RELATED INFORMATION
S109
CONTINUE ?
S114
YES
NO
END

FIG. 4

REGISTRATION IDENTIFIER	PRESENT POSITION OR STARTING POINT	DESTINATION	OPTIMUM-ROUTE SEARCH METHOD IDENTIFIER	RELATED INFORMATION REQUIREMENT IDENTIFIER

FIG. 5

REGISTRATION IDENTIFIER	REGISTERED DATA TYPE	DATA AMOUNT	CHARGE AMOUNT	FREQUENCY OF LOG-IN	TOTAL DATA AMOUNT	TOTAL BILLING AMOUNT

FIG. 6

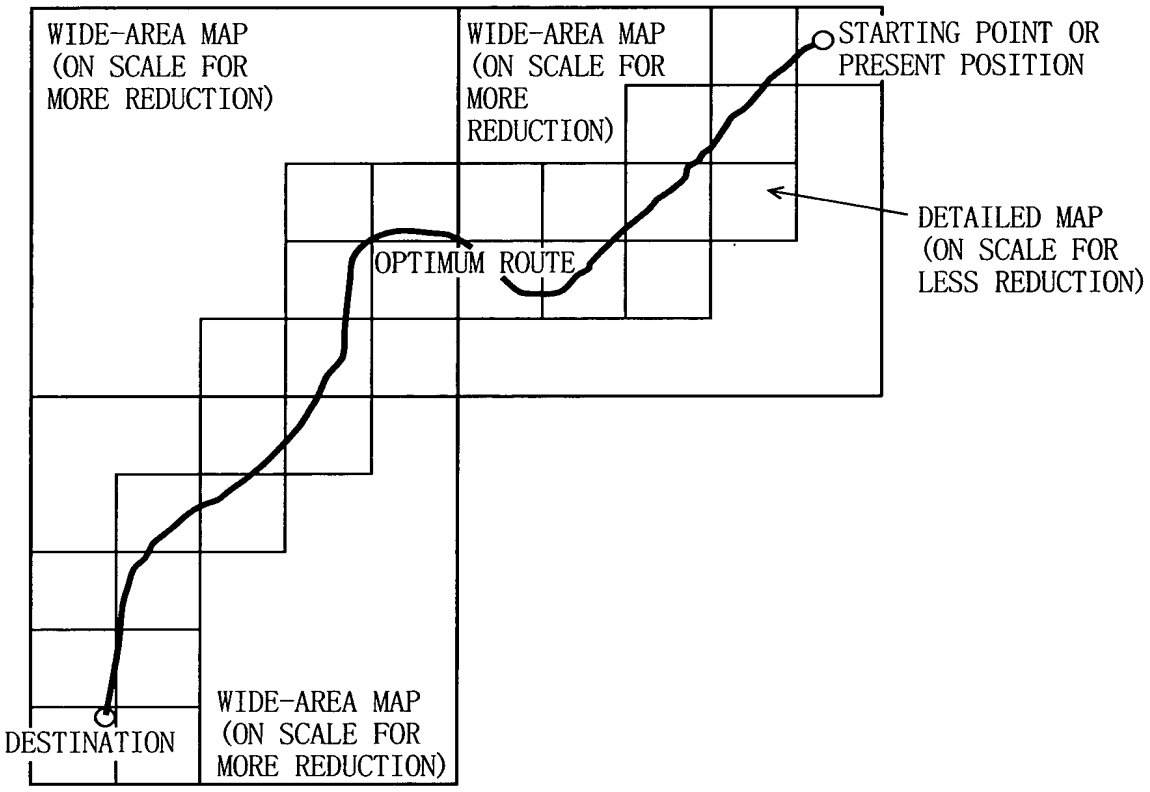
WIDE-AREA MAP
(ON SCALE FOR
MORE REDUCTION)
WIDE-AREA MAP
(ON SCALE FOR
MORE
REDUCTION)
STARTING POINT OR
PRESENT POSITION
DETAILED MAP
(ON SCALE FOR
LESS REDUCTION)
OPTIMUM ROUTE
DESTINATION
WIDE-AREA MAP
(ON SCALE FOR
MORE REDUCTION)

FIG. 7A

INFORMATION TYPE		UNIT PRICE
MAP DATA		10 YEN/SHEET
RELATED INFORMATION	TRAFFIC JAM	50 YEN/AREA
	EVENT/ DISCOUNT SALE	20 YEN/AREA
	SIGHTSEEING INFORMATION	10 YEN/AREA

FIG. 7B

INFORMATION TYPE		UNIT PRICE
MAP DATA		10 YEN/1MB
RELATED INFORMATION	TRAFFIC JAM	50 YEN/1KB
	EVENT/ DISCOUNT SALE	20 YEN/1KB
	SIGHTSEEING INFORMATION	10 YEN/1KB

FIG. 8A

INFORMATION TYPE		THE NUMBER OF SHEETS OR AREAS	PRICE
MAP DATA		2	20 YEN
RELATED INFORMATION	TRAFFIC JAM	2	100 YEN
	EVENT/ DISCOUNT SALE	—	—
	SIGHTSEEING INFORMATION	2	20 YEN
TOTAL CHARGE		140 YEN	

FIG. 8B

INFORMATION TYPE		INFORMATION AMOUNT	PRICE
MAP DATA		2MB	20 YEN
RELATED INFORMATION	TRAFFIC JAM	1.5KB	75 YEN
	EVENT/ DISCOUNT SALE	—	—
	SIGHTSEEING INFORMATION	3KB	30 YEN
TOTAL CHARGE		125 YEN	

FIG. 9

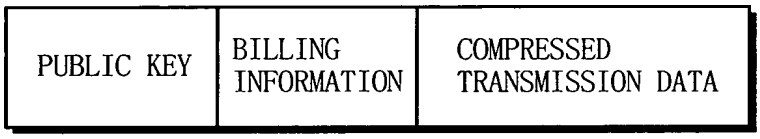
PUBLIC KEY
BILLING INFORMATION
COMPRESSED TRANSMISSION DATA

FIG. 10

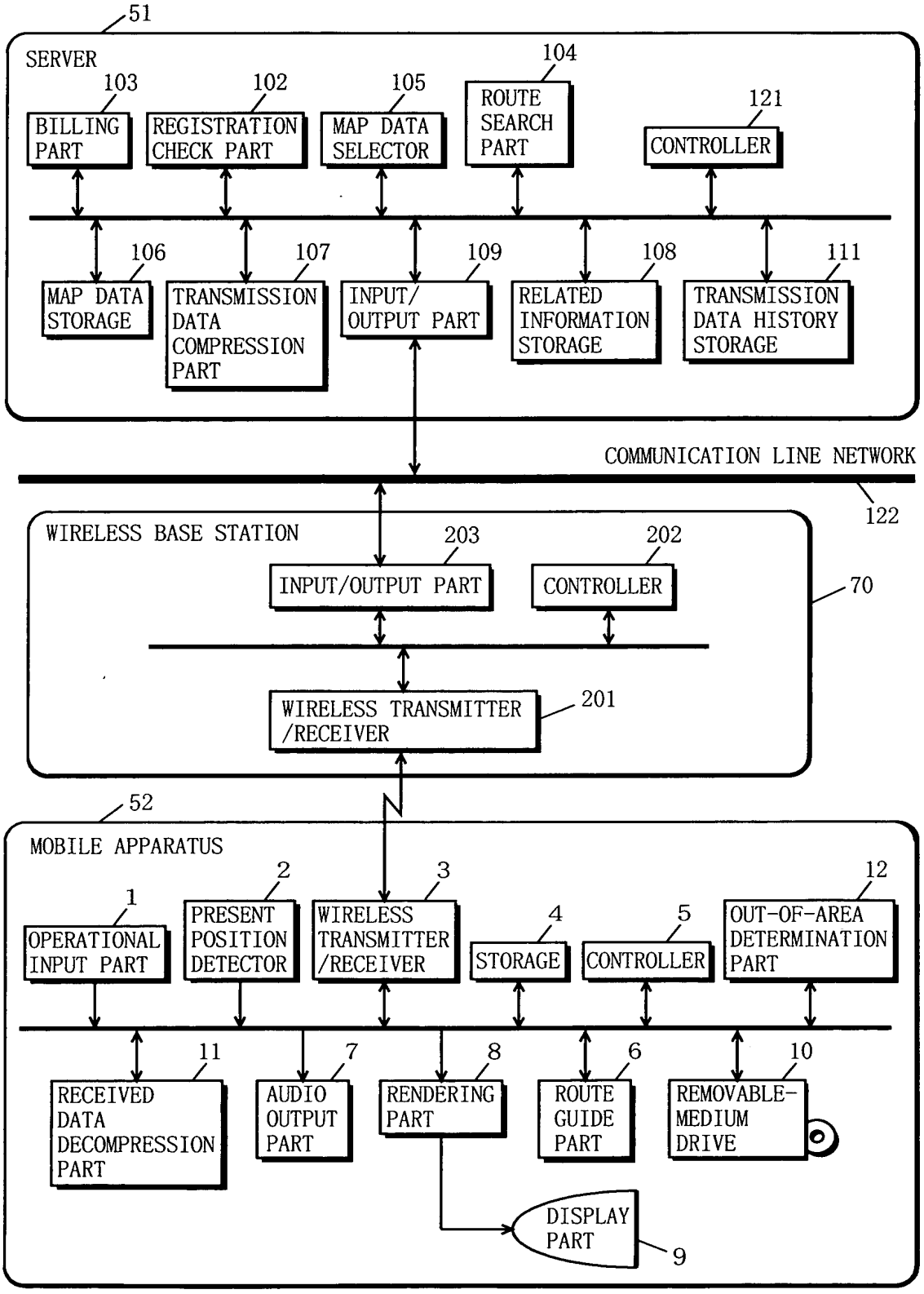
51
SERVER
103
BILLING PART
102
REGISTRATION CHECK PART
105
MAP DATA SELECTOR
104
ROUTE SEARCH PART
121
CONTROLLER
106
MAP DATA STORAGE
107
TRANSMISSION DATA COMPRESSION PART
109
INPUT/ OUTPUT PART
108
RELATED INFORMATION STORAGE
111
TRANSMISSION DATA HISTORY STORAGE
COMMUNICATION LINE NETWORK
122
WIRELESS BASE STATION
203
INPUT/OUTPUT PART
202
CONTROLLER
70
WIRELESS TRANSMITTER /RECEIVER
201
52
MOBILE APPARATUS
1
OPERATIONAL INPUT PART
2
PRESENT POSITION DETECTOR
3
WIRELESS TRANSMITTER /RECEIVER
4
STORAGE
5
CONTROLLER
12
OUT-OF-AREA DETERMINATION PART
11
RECEIVED DATA DECOMPRESSION PART
7
AUDIO OUTPUT PART
8
RENDERING PART
6
ROUTE GUIDE PART
10
REMOVABLE-MEDIUM DRIVE
DISPLAY PART
9

FIG. 11

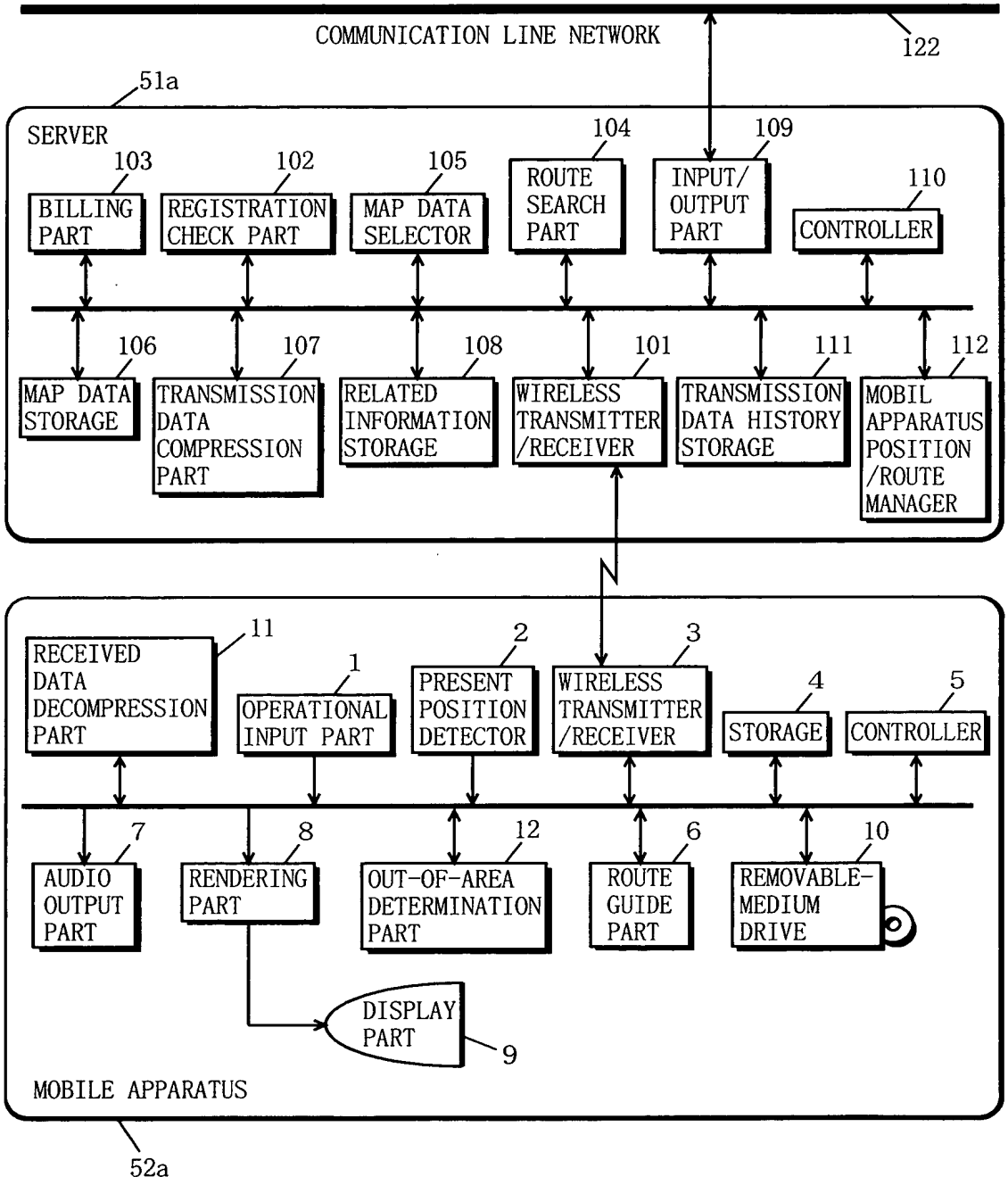
COMMUNICATION LINE NETWORK
122
51a
SERVER
103
BILLING PART
102
REGISTRATION CHECK PART
105
MAP DATA SELECTOR
104
ROUTE SEARCH PART
109
INPUT/ OUTPUT PART
110
CONTROLLER
106
MAP DATA STORAGE
107
TRANSMISSION DATA COMPRESSION PART
108
RELATED INFORMATION STORAGE
101
WIRELESS TRANSMITTER /RECEIVER
111
TRANSMISSION DATA HISTORY STORAGE
112
MOBIL APPARATUS POSITION /ROUTE MANAGER
11
RECEIVED DATA DECOMPRESSION PART
1
OPERATIONAL INPUT PART
2
PRESENT POSITION DETECTOR
3
WIRELESS TRANSMITTER /RECEIVER
4
STORAGE
5
CONTROLLER
7
AUDIO OUTPUT PART
8
RENDERING PART
12
OUT-OF-AREA DETERMINATION PART
6
ROUTE GUIDE PART
10
REMOVABLE-MEDIUM DRIVE
DISPLAY PART
9
MOBILE APPARATUS
52a

FIG. 12A

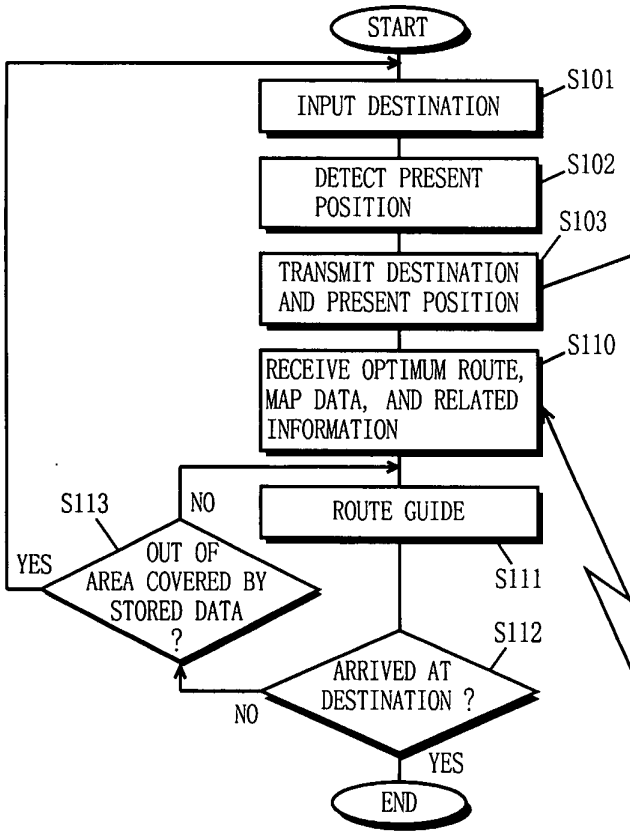

FIG. 12B

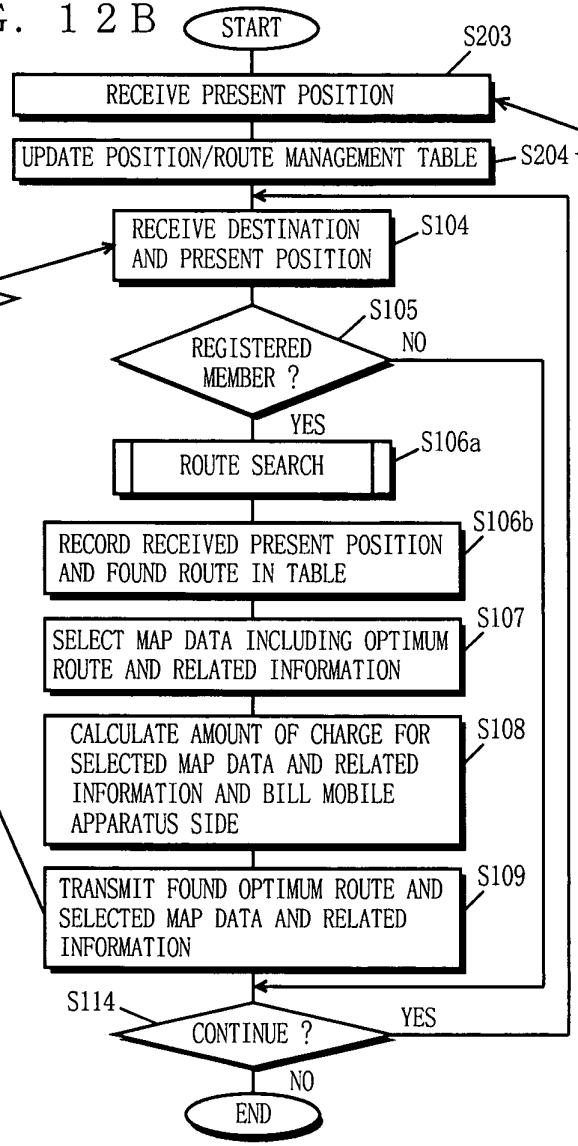

FIG. 12C

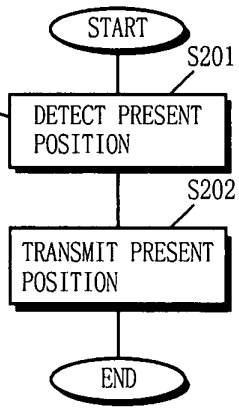

FIG. 13

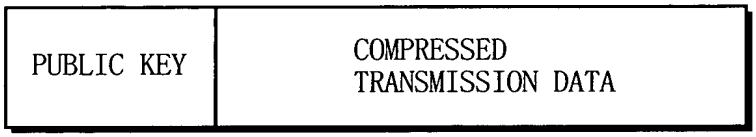

FIG. 14

	PRESENT POSITION	FOUND ROUTE
MOBILE APPARATUS 1		
MOBILE APPARATUS 2		
⋮		

FIG. 15

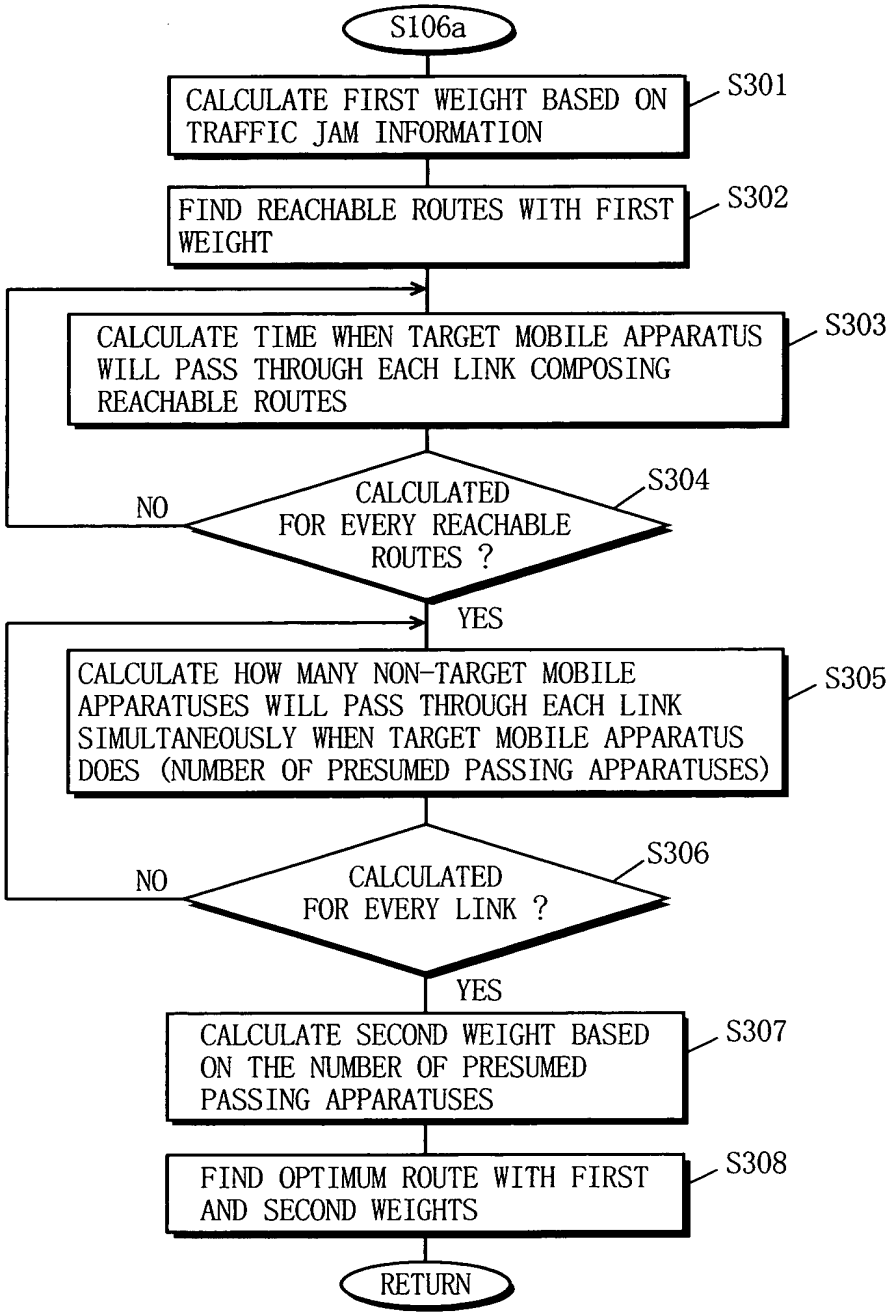
S106a
CALCULATE FIRST WEIGHT BASED ON TRAFFIC JAM INFORMATION
S301
FIND REACHABLE ROUTES WITH FIRST WEIGHT
S302
CALCULATE TIME WHEN TARGET MOBILE APPARATUS WILL PASS THROUGH EACH LINK COMPOSING REACHABLE ROUTES
S303
CALCULATED FOR EVERY REACHABLE ROUTES ?
S304
NO
YES
CALCULATE HOW MANY NON-TARGET MOBILE APPARATUSES WILL PASS THROUGH EACH LINK SIMULTANEOUSLY WHEN TARGET MOBILE APPARATUS DOES (NUMBER OF PRESUMED PASSING APPARATUSES)
S305
CALCULATED FOR EVERY LINK ?
S306
NO
YES
CALCULATE SECOND WEIGHT BASED ON THE NUMBER OF PRESUMED PASSING APPARATUSES
S307
FIND OPTIMUM ROUTE WITH FIRST AND SECOND WEIGHTS
S308
RETURN

FIG. 16

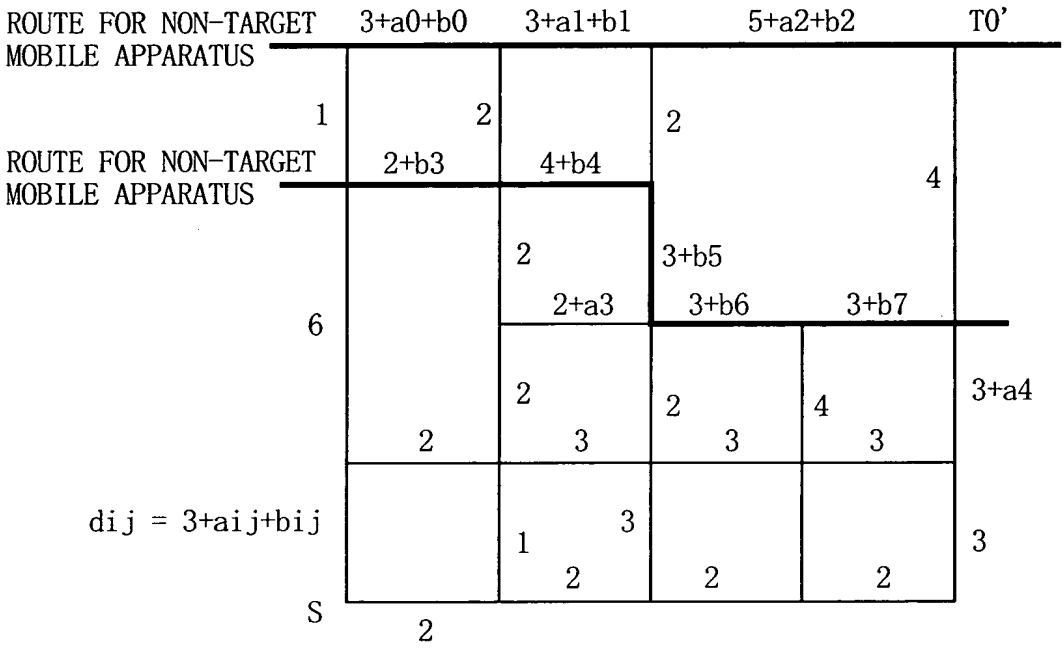
ROUTE FOR NON-TARGET MOBILE APPARATUS
3+a0+b0
3+a1+b1
5+a2+b2
T0'
1
2
2
ROUTE FOR NON-TARGET MOBILE APPARATUS
2+b3
4+b4
4
2
3+b5
2+a3
3+b6
3+b7
6
2
2
3
2
3
4
3
3+a4
dij = 3+aij+bij
1
3
2
2
2
3
S
2

FIG. 17

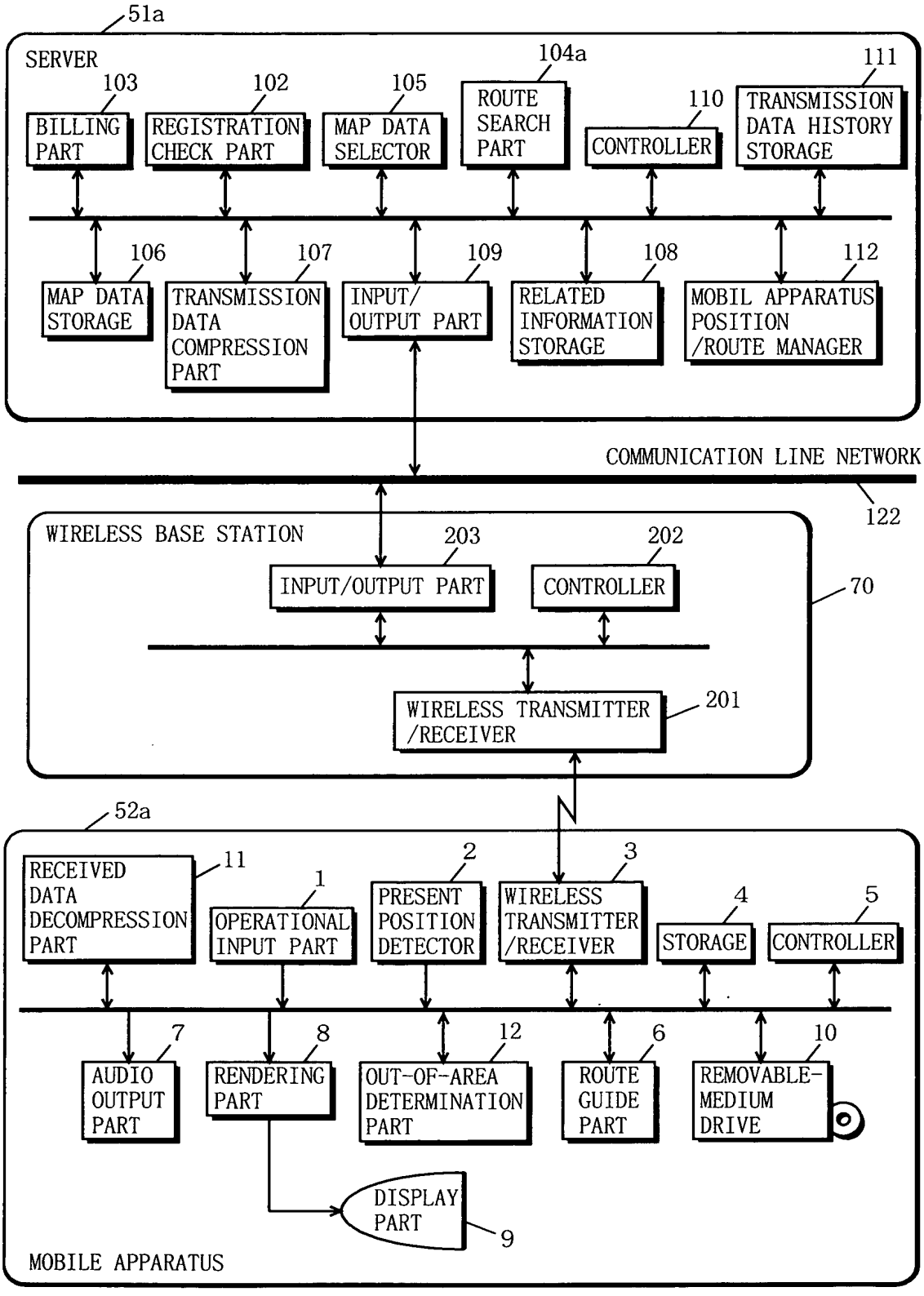
51a
SERVER
103
BILLING PART
102
REGISTRATION CHECK PART
105
MAP DATA SELECTOR
104a
ROUTE SEARCH PART
110
CONTROLLER
111
TRANSMISSION DATA HISTORY STORAGE
106
MAP DATA STORAGE
107
TRANSMISSION DATA COMPRESSION PART
109
INPUT/ OUTPUT PART
108
RELATED INFORMATION STORAGE
112
MOBIL APPARATUS POSITION /ROUTE MANAGER
COMMUNICATION LINE NETWORK
122
WIRELESS BASE STATION
203
INPUT/OUTPUT PART
202
CONTROLLER
70
WIRELESS TRANSMITTER /RECEIVER
201
52a
RECEIVED DATA DECOMPRESSION PART
11
OPERATIONAL INPUT PART
1
PRESENT POSITION DETECTOR
2
WIRELESS TRANSMITTER /RECEIVER
3
STORAGE
4
CONTROLLER
5
AUDIO OUTPUT PART
7
RENDERING PART
8
OUT-OF-AREA DETERMINATION PART
12
ROUTE GUIDE PART
6
REMOVABLE-MEDIUM DRIVE
10
DISPLAY PART
9
MOBILE APPARATUS

FIG. 18 PRIOR ART

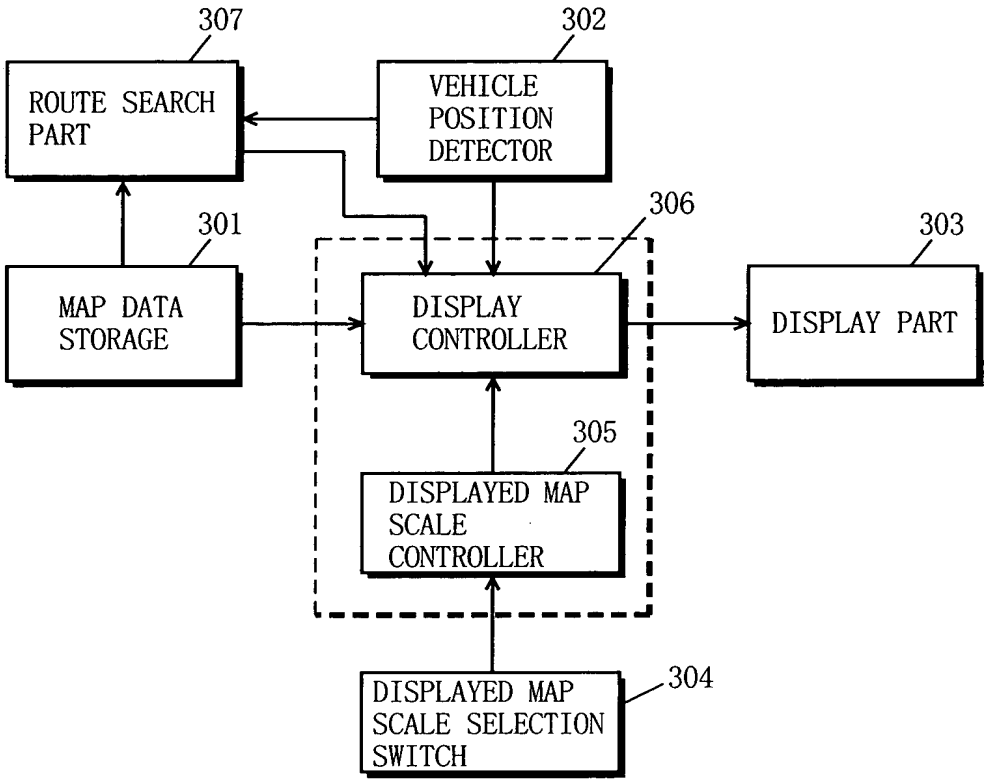

FIG. 19 PRIOR ART

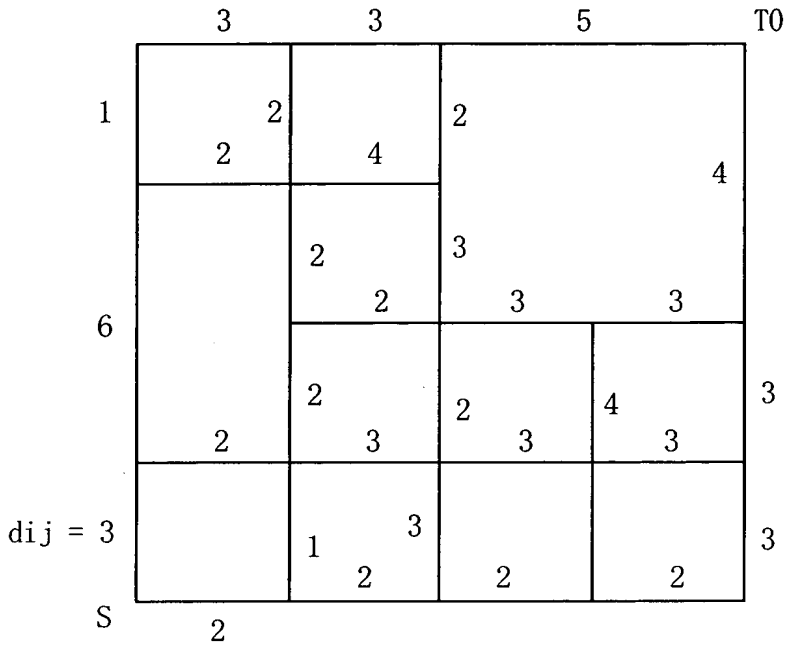
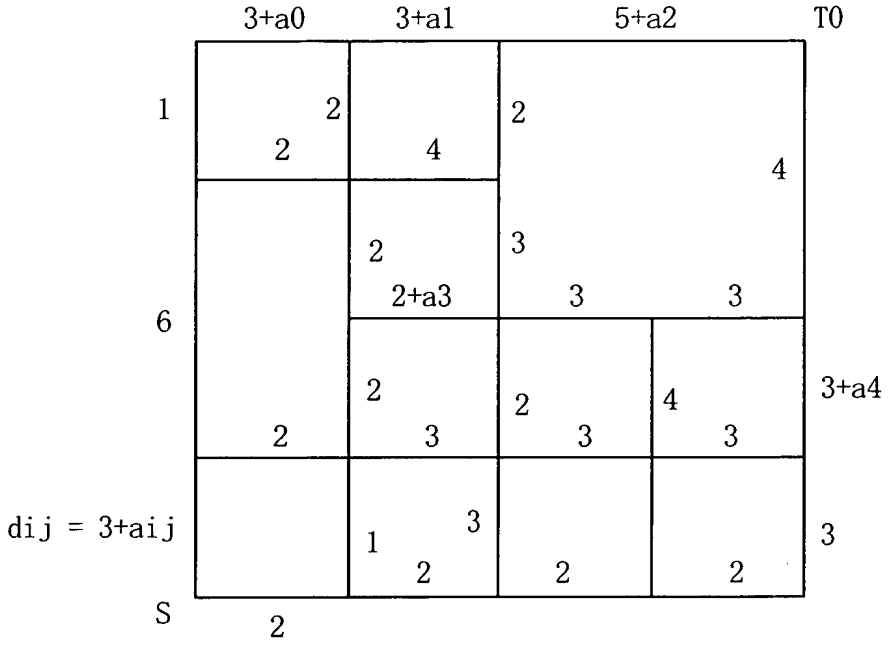
FIG. 20 PRIOR ART